

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: Takao SAITO, Yukinori NAKAMURA, Yoshimasa
KONDO and Naoto OHTAKE

Serial No.: 10/774,454

Group Art Unit: 1792

Filed: February 10, 2004

Examiner: David P. Turocy

Conf. No.: 9153

For: THIN FILMS AND A METHOD FOR PRODUCING THE SAME

DECLARATION UNDER 37 CFR §1.132

Sir:

I, Takao Saito, a citizen of Japan hereby declare and state:

1. I have a doctor of philosophy degree in engineering which was conferred upon me by Tohoku University in Miyagi Prefecture in 2001.
2. I have been employed by NGK Insulators, Ltd. since 2001 and I have had a total of 9 years of work and research experience in pulse plasma technology.
3. I am one of the inventors of the above-identified patent application and I am familiar with the references applied in the Office Action mailed December 1, 2009.
4. The following experiments were conducted under my direct supervision.

5. A thin film of diamond like carbon film was produced according to the process described in "Example 1" of the specification. More specifically, the system of Fig. 2 was used to produce the film with an electric source utilizing a static induction thyristor device as the electric source 3. The chamber 1 was made of stainless steel. The lower electrode 5 had a diameter of 50 mm. The substrate 6 composed of a silicon substrate was mounted on the electrode 5. The upper electrode 4 was provided over the surface of the substrate 6 at a height of 10 mm. The surface of the upper electrode 4 had a diameter of 10 mm. The surfaces of the lower electrode 5 and upper electrode 4 were not covered with glass (dielectric material).

An oil-sealed rotary vacuum pump was used to evacuate the chamber 1 until the pressure in the chamber 1 reached 0.1 Torr. Helium gas was then supplied into the chamber 1 through the gas supply hole 2 until the pressure in the chamber 1 reached about 300 Torr. A pulse voltage was applied on the upper electrode 4 and lower electrode 5 while a mixed gas of 0.5 liter/min of methane gas and 10 liter/min of helium gas was introduced through the gas supply hole 2. The pulse voltage had a peak value of - 15 kV, a frequency of 1000 Hz, a rise time of 150 nsec, a fall time of 150 nsec, and a pulse duration of 300 nsec. The pulse voltage was applied so that electric discharge was maintained for 10 minutes to form a thin film 7 of diamond like carbon on the substrate 6.

6. The thus obtained thin film of diamond like carbon was subjected to Raman spectroscopic analysis using a system for Raman spectroscopy (supplied by JASCO Corporation: "NRS-1000"). The result of the Raman spectroscopic analysis was a shoulder peak confirmed at a wave number of 1350 to 1450 cm^{-1} , as well as a main peak at about 1580 cm^{-1} , which is consistent with substantially amorphous diamond like carbon film.

7. The same procedure described in the Inventive Example 1 was carried out, except that nitrogen gas was supplied into the chamber 1 through the gas supply hole 2 until the pressure in the chamber 1 reached about 300 Torr, and then a mixed gas of 0.5 liter/min of methane gas and 8 liter/min of nitrogen gas was introduced through the gas supply hole 2, instead of introducing helium gas. The result of this procedure was that an arc discharge was observed and the state of plasma was too unstable to be used to form a deposited film.

8. The same procedure described in the "Example 1" was carried out, except that the surfaces of the lower electrode 5 and upper electrode 4 were covered with glass. The result of this procedure was that an arc discharge was not observed and the state of plasma was stable, but a diamond like carbon film could not be formed on the substrate 6.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine and/or imprisonment under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date: Mar. 31, 2010

Takao Saito
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